

IS ECONOMICS A SCIENCE? FINDINGS AND ESTIMATES IN SCIENTIFIC AND ECONOMIC TEXTS

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1. Introduction

Is economics a science? Economists like Milton Friedman and George Stigler, both Nobel laureates, have insisted it is.¹ Others, like Hazel Henderson and Nicholas Georgescu-Roegen, also economists,² have joined the chorus of natural scientists who have insisted it is not. Let it be clear from the outset, however, that this chapter does not aim to contribute to this periodically surfacing debate. The first part of its title is merely an attention getter. Its author is neither an economist nor a scientist (in the restricted and now dominant sense of ‘a practitioner of natural science’)³ but a linguist, and though some linguists can undoubtedly sympathize with the discomfort this question arouses in some economists (a very similar question regularly crops up in linguistics as well), the extent to which economics is a science is an issue linguists cannot possibly hope to decide. What they can do, though, is illuminate to what extent economists write and talk like scientists when they report on their research. This, of course, is much less of a burning concern in economics than the other question. Still, it is something that could interest the linguistically-aware economist, as well as (some) linguists and certain teachers of ‘language for (certain) specific purposes’. It is hoped at least that it will interest the man in whose honour this volume was compiled, both as a linguist and as a teacher of English in a school of economics.

To what extent do economists speak and write the way scientists do in their academic texts? This is a huge question, of course, of which any linguistic investigation can only seek to answer a tiny aspect. The choice of the particular focus for this contribution is very much the result of my continued interest in a grammatical construction available to writers (more readily than speakers) of English to

1 See for instance Friedman (1953) and Stigler (1982).

2 See for instance Henderson (1981) and Georgescu-Roegen (1971).

3 Cf. The Oxford English Dictionary s.v. science, sense 5.b.

signal evidentiality, viz. the construction one could term the *be said to* construction, after its most typical representative, illustrated in (1).⁴

- (1) STUDYING the West Coast of Scotland from the yacht Britannia, the Queen *is said to* have remarked, not long ago, that the people there didn't seem to have much of a life. (A05 1561)

(2)-(6) are examples of a few other typical instantiations of the construction.

- (2) Richard Dennick, 22, who was convicted at Chester Crown Court in 1983, *is thought to* have used a blanket rope to escape from Lewes prison, East Sussex. (A1J 338)
- (3) Tropical Plant Rentals, acquired in October 1988 for \$41.5m, *is believed to* have accounted for a decline in margins in Rentokil's environmental services division from 25.8 per cent to 23.1 per cent in the first half of 1989. (A1S 73)
- (4) TROUBLED defence electronics group Ferranti International Signal *is reported to* have reached a compromise with West Germany's Telefunken Systems Technik over their rival bids to supply the radar for the European Fighter Aircraft. (A94 171)
- (5) The loss of ozone during the Arctic winter *is shown to* be up to 35 per cent rather than 10 per cent to 25 per cent as indicated by previous analysis of the data. (J2N 564)
- (6) This relief cost the Exchequer £1.1 billion in 1978/79, but *is estimated to* have reached £7 billion in 1989/90 (see Figure 8.3). (CE8 1299)

Evidentiality can be loosely defined as the expression of the kind of evidence a person has for making factual claims (Anderson 1986, 273). The italicized patterns in the sentences in (1) to (6) do just that. I have previously characterized their general functional contribution to the meaning of the sentences they are part of somewhat technically as follows: they signal that the writers of these sentences are not the (sole) judge of the factuality of the statements they express by calling in an unspecified source from whose implied existence the relative factuality of the

4 All examples are taken from the second version (the so-called 'World Edition', released in December 2000) of the British National Corpus (BNC), a principled collection of almost 100 million words of digitized texts taken from different (mainly written) genres (for a description of the corpus, see Aston and Burnard 1998). In the source code that follows each example the three positions before the space identify the excerpt it was extracted from (which can be looked up in Burnard 1995); the number following the space is the line number of the example within the excerpt. Italics were added to the examples to highlight the constructions under discussion; the words in capitals at the start of some of the examples were there originally and signal that they are the initial sentences of newspaper texts.

statements can be inferred (Noël 2001). In much less technical terms, their function is to add credence to these statements through the suggestion of an information source.

In English the expression of evidentiality is very much an optional choice, but one can expect it to be made more often in texts in which factuality is required. It is not a coincidence that the source texts of the above examples are either of an academic nature (examples 1, 5 and 6) or of a journalistic one (examples 2 to 4). One may expect journalists and academics, and academics from different disciplines, to work with different kinds of evidence, however. Hearsay evidence, for instance, may be perfectly acceptable in journalism and an important kind of evidence in some of the humanities, but is hardly satisfactory in the natural sciences. Given that different realizations of the *be said to* construction seem to point to different kinds of evidence, one might therefore expect the texts belonging to different academic disciplines to show up a different preponderance of such patterns.

Science works with hypotheses, experiments, data, findings and predictions based on these findings. The detractors from the position that economics is a science argue that this is not how economics operates. The heterodox economist E. F. Schumacher, for instance, ends a rather stringent review of a study dealing with a vast array of questions related to fuel and energy in the then European Community in the following way:

It is fashionable to-day to assume that any figures about the future are better than none. To produce figures about the unknown, the current method is to make a guess about something or other — called an ‘assumption’ — and to derive an estimate from it by subtle calculation. The estimate is then presented as the result of scientific reasoning, something far superior to mere guesswork. This is a pernicious practice which can only lead to the most colossal planning errors, because it offers a bogus answer where, in fact, an entrepreneurial judgment is required.

The study here under review employs a vast array of arbitrary assumptions, which are then, as it were, put into a calculating machine to produce a ‘scientific’ result. It would have been cheaper, and indeed more honest, simply to assume the result. (Schumacher 1964, 194)

Far be it for me to claim that this is an accurate representation of most of what goes on in economics as an academic discipline (more than forty years on), but opinions like these could lead one to expect either of two opposing states of affairs with relation to the choice of evidential expressions in economics texts. Irrespective of whether economics is a science or not, its practitioners may linguistically behave like scientists and employ the same kind of language. Consequently, they adopt identical evidential expressions. If, on the other hand, science is all about experiments and findings whereas economics is much more about estimates, as Schumacher seems to suggest, and this is reflected in the language em-

ployed, including the choice of evidentials, one might expect the evidential used in (7) to be uncharacteristic and the one used in (8) to be characteristic of economics texts.

- (7) SSPE is a chronic, progressive form of encephalitis which can cause behavioural changes, dementia, (myoclonic) jerks and eventually death. The brains of its victims *are found to* contain areas in which the death of nerve cells is accompanied by demyelination (the break up of the fatty sheath surrounding nerve fibres, which is essential to their correct functioning). (B77 1294)
- (8) In the UK, the assets in pension schemes *are estimated to* be over £300 billion. (HBU 48)

As suggested by its subtitle, this contribution will (eventually) focus on the relative distribution of *be found to* and *be estimated to* in texts produced in the (natural) sciences and in economics. However, for a good understanding, some of the more general points made in this introduction will be elaborated on a little before turning to this specific issue in section 4. Section 2 will summarize the arguments for calling the patterns illustrated here instantiations of a grammatical evidential construction. Section 3 will detail which verbs are most frequently entered into the construction and will provide corpus-based evidence that these instantiations are not distributed equally over all contextual domains.

2. The evidential *be said to* construction

The aim of this section is to convince the economist, the scientist and the linguist alike that the patterns under discussion have an evidential function, and the linguist in particular that they are grammatical constructions (which the economist and the scientist might be less interested in). Let us start with a definition:

Evidentiality is a linguistic category whose primary meaning is source of information. [...] [T]his covers the way in which the information was acquired, without necessarily relating to the degree of speaker's certainty concerning the statement or whether it is true or not. (Aikhenvald 2004, 3)

Of course, in English, as in about 75% of the world's languages, evidentiality is hardly grammaticalized, i.e. it is not a grammatical category on a par with categories like person, number, tense and aspect. A speaker's or writer's decision to use an evidential expression is an optional choice, not a necessary one, unlike in the remaining quarter of the world's languages, where 'every statement must specify the type of source on which it is based — for example, whether the speaker saw it, or heard it, or inferred it from indirect evidence, or learnt it from someone else' (Aikhenvald 2004, 1). For linguistic typologists like Aikhenvald the absence of

such a necessity is reason enough to say that there is no grammatical evidentiality in English. English does have patterns like *I guess*, *they say*, *it seems to me that*, etc., and verbs like *allege* and adverbs like *reportedly* (also see Chafe 1986), but these are not only optional specifications of the source of knowledge, they are also ‘lexical’, says Aikhenvald (2004, 10). Others have argued, however, that some of these patterns are cases of what Hopper and Traugott (2003[1993], 34) — in their Cambridge Textbooks in Linguistics title on grammaticalization — call ‘incipient grammaticalization’. Thompson and Mulac (1991), for instance, have discussed patterns like *I think* and *I guess*, as exemplified in (9) and (10), in terms of grammaticalization: they are not main clauses containing the lexical reporting verbs *think* and *guess*, but ready-to-use grammatical units functioning as epistemic/evidential adverbs.

- (9) Levi would have understood that challenge, just as *I think* he would have been happy to agree that it is possible to speak without contradiction of the literal imagination. (A05 1462)
- (10) If you were to draw up the specification for the ideal material for electronic engineering, *I guess* it would be something combining the properties of the perfect conductor, the perfect insulator and the ideal semiconductor. (A19 255)

I myself have argued in earlier work that patterns like *be said to*, *be thought to*, *be believed to*, etc., are often no longer part of matrix/report clauses introducing infinitival subclauses, but instead are evidential auxiliaries accompanying main verbs (Noël 2001). Let me reiterate the main arguments in favour of such an analysis.

It might help readers to appreciate why such a claim needs to be made in the first place, if they consider the contrast between the extracts in (11)-(13) and (14)-(16).

- (11) Sometimes authorities are understood to be limited by the kinds of acts which they can or cannot regulate (given some restrictive ways of classifying acts). In this book authorities *are said to* be limited also by the kinds of reasons on which they may or may not rely in making decisions and issuing directives, and by the kind of reasons their decisions can preempt. (ANH 148)
- (12) In one London area where 15 percent of the general population is black, black people make up a third of all psychiatric admissions under the age of 65 years. Why? The following reasons have been suggested: 1. [...] 2. [...] 3. [...] 4. The high rates of diagnosis of schizophrenia among black people *were* at one time *thought to* be due to widespread misdiagnosis of bizarre behaviour and transient hallucinatory experiences by white psychiatrists unfamiliar with normal Afro-Caribbean cultural expressions of severe distress. It is now clear that this is no longer an adequate explana-

- tion and that the rates of schizophrenia in British black young people are worryingly high. (FYW 1287)
- (13) The walk to Whernside's top from Ingleton is a full day's expedition, a test of stamina, with little of immediate interest in the later stages. [...] At long length, the slope of the ridge, so far imperceptible, becomes more pronounced, raising hopes that the summit is near— but disappointment follows when, on topping the rise, it *is seen to* be succeeded by others. (ASU 702)
- (14) INDEPENDENTS GET BREAK FROM BRAVO
by David Goymour
BRAVO, a new on-screen booking system which puts British hotels and tourist attractions on travel agents' counters, has entered its launch phase. It *is said to* offer independent hotels the kind of exposure which hotels in big groups can derive from international booking systems — owned, typically, by the big airlines. (A0C 456)
- (15) FARMER SEES FINANCIAL SENSE IN GOING GREEN
by Mike Prestage
HILL FARM, in the heart of south Somerset, is about to undergo a revolution that will be watched with interest by neighbours and from further afield. It *is thought to* be the largest British dairy farm to go green, and the conversion — for deeply held environmental reasons — is backed by sound economic logic. (A4K 60)
- (16) [...] Fig. 15.3. This figure reveals that around 49% of general government expenditure involves public sector pay plus the purchase of goods and services for consumption by the public. Over 32% is absorbed by the 'disadvantaged' in the form of pensions, unemployment and supplementary benefits, etc. (transfers to personal sector). A further 2.8% goes into transfers to industry (the corporate sector). Capital spending *is seen to* total some 7.8% of general government expenditure and covers spending on new construction, land, building and other physical assets, as well as grants to the private sector, the nationalized industries and other public corporations (see also Fig. 15.5). (H7T 351)

Both (11) and (14) contain a form of the pattern *be said to*, but whereas in (11) the meaning of *said* is put 'on stage' by the prepositional phrase *in this book*, it very much remains 'off stage' in (14). (11) 'is about' what someone has claimed somewhere, but in (14) there is no explicit reference to any aspect of a situation in which information is exchanged. The fact that someone has 'said' something is very much part of the propositional content of (11), but much less so, or not at all, in (14). Here *is said to* merely signals its writer is not making things up. In (12), *be thought to* is used to refer to ideas that were held *at one time*, but though the same

pattern is used in (15), this extract is not ‘about’ people’s beliefs. In (15), *is thought to* has the same general function as *is said to* in (14). In (13), *be seen to* refers to a particular visual experience, but not so in (16), where there is no reference as such to any perception, either of an individual or of a group of individuals. Here the pattern is used to indicate that the sentence it is part of contains a claim based on the data represented in the figure referred to explicitly a few sentences before in the extract.

In other words, in terms of the Hallidayan distinction between ideational, interpersonal and textual meanings (see, for instance, Halliday 1994[1985]), *be said to*, *be thought to* and *be seen to* are used ideationally/textually in the first set of examples, and interpersonally in the second set. In the first set they are passive patterns used for information/thematic structural reasons and the utterance, cognition and perception verbs in them have their full lexical meanings. In the second set the patterns are arguably no longer passives of lexical verbs, but — in Traugottian terms — ‘grammatically identifiable expression[s] of speaker belief or speaker attitude to what is said’ (Traugott 1995, 32). They point to the source of what is said/evidence for what is said. The verbs in them have lost some of their ‘objective’ meaning, to the extent that they do not refer to identifiable utterance acts or acts of cognition or perception. In its place has come what Traugott (1995) calls ‘subjective’ meaning. The patterns these verbs are part of are subjective intrusions by the writer that modify the propositional content of the message in the way described above, i.e. evidentially. Loss of meaning (‘bleaching’) coupled with ‘subjectification’ is very much part of grammaticalization generally, i.e. of ‘the change whereby lexical items and constructions come in certain linguistic contexts to serve grammatical functions’ (Hopper and Traugott 2003, xv). There is a case to be made, therefore, for calling these patterns ‘grammatical’ expressions of evidentiality.

Another argument for saying that the illustrated patterns should not always be considered to be passives is that, on the whole, they occur more frequently than their active counterparts (so-called ‘accusative and infinitives’ or ‘ACIs’, an example is 17; for details on frequencies, see Noël 2001). Passives generally do not occur more frequently than actives, so this is something in need of an explanation. Part of the explanation might be that they have a function that is different from the general functionality of passives.

- (17) The Committee on Nursing (1972), chaired by Professor Asa Briggs, stated that it *believed nursing to be* the major caring profession. (B33 5)

These ‘nominative and infinitives’ (or ‘NCIs’) — as one could call them as well, by analogy with one of the passive versions of the ACI in Latin grammar — are also different from ACIs in that they combine much more frequently with lexical infinitives, i.e. infinitives other than *be* and *have*. Examples like (18)-(20) are quite

common, whereas (21) is an example of a much less usual pattern (again, for frequencies, see Noël 2001).

- (18) In dry and settled weather conditions it is quite safe to leave gliders out overnight. However, permanent parking outside in all weathers has *been shown to cause* rapid deterioration to the finish of all non-metal gliders. (A0H 225)
- (19) The logging of timber *is estimated to destroy or damage* 12.5 million acres of tropical forests every year. (BN4 918)
- (20) Criminal law *is assumed to express and reflect* the interests of the ruling class. (B17 434)
- (21) Abrams *believed neighbouring to hang* on a dilemma which those who live near to each other have between the need for support in times of crisis and the need for privacy. (CS7 434)

This greater compatibility with lexical verbs can be construed as a case of the ‘host-class expansion’ that is often involved in grammaticalization, i.e. the expansion of the class of elements a grammaticalizing element is in construction with (Himmelmann 2004, 32). It also makes these patterns amenable to an analysis as auxiliaries, not unlike the futurity marker *be going to* and the modal marker *be able to* (see Noël 2001 for a much more elaborate argumentation in favour of their auxiliary-ness).

There is reason enough, therefore, not to call the patterns that instantiate the evidential *be said to* construction purely lexical expressions of evidentiality. The next section will examine which specific patterns instantiate the construction most frequently and whether these are distributed evenly over different contextually defined domains.

3. Instantiations of the evidential *be said to* construction and their genre-specificity

What are the forms the *be said to* construction can take? A somewhat more technical representation of the form of this schematic construction is the following: [SBJ (*be*-TNS) VERB_{PCU}-*en to* VERB-inf].⁵ In other words, there is a subject, an optional tensed form of the verb *be*, a ‘past participle’ form of an utterance, cognition or perception verb (which together form a class of verbs Givón 1990 has grouped as

5 This is a ‘schematic’ construction in the sense that not all of its positions are lexically specified and that it is a generalization over different ‘substantive’, lexically specified, instantiations. For exemplification of the cline from fully substantive to fully schematic constructions, see Goldberg (2003: 220) and Croft and Cruse (2004: 255).

P-C-U verbs) and a *to*-infinitive. To find out which P-C-U verbs can be entered into the construction we searched the British National Corpus for any form of the verb *be* followed by any word, in turn followed by the infinitival particle *to*.⁶ The manually filtered-out results produced the list of verbs in (22), ordered by descending frequency (with absolute frequencies specified between brackets).

- (22): expect (6007), say (3588), suppose (3338), think (1735), find (1572), see (1363), know (1242), believe (1164), report (1074), show (981), consider (857), hold (539), deem (519), assume (505), take (460), estimate (352), claim (300), understand (281), allege (276), feel (226), repute (170), presume (162), schedule (162), judge (141), guarantee (136), perceive (115), hear (110), prove (104), reckon (101), rumour (97), observe (69), forecast (66), predict (65), project (55), tip (47), discover (46), declare (43), calculate (40), express (39), acknowledge (38), interpret (37), recognize (36), define (33), state (30), argue (25), demonstrate (24), anticipate (21), adjudge (20), suggest (20), reveal (17), agree (16), note (15), suspect (15), fear (13), hope (13), construe (12), admit (11), confirm (10), propose (8), conceive (7), fancy (7), specify (6), determine (5), imagine (5), overhear (5), accept (4), postulate (4), purport (4), assess (3), nap (3), pronounce (3), slate (3), announce (2), certify (2), decree (2), hypothesize (2), measure (2), notice (2), record (2), simulate (2), appreciate (1), ascertain (1), assert (1), concede (1), conclude (1), contemplate (1), decide (1), deduce (1), deign (1), deny (1), describe (1), detect (1), diagnose (1), envisage (1), establish (1), esteem (1), indicate (1), infer (1), learn (1), misinterpret (1), notify (1), presuppose (1), proclaim (1), prophesy (1), regard (1), represent (1), sense (1), swear (1), threaten (1), translate (1), view (1), whisper (1)

Two notes of warning are in order, however. First, this is a list of verbs that can be entered into the construction, not a frequency count of attestations of the evidential *be said to* construction, since, as explained above, the pattern searched for can also be used ideationally. Second, two verbs that occur at the start of the list, viz. *expect* and *suppose*, might well do so by virtue of the fact that they also help to instantiate a deontic construction (exemplified in 23 and 24) which is formally identical to the ideational pattern and the evidential construction (evidential examples are 25 and 26). The extent to which this is the case remains to be sorted out, but for this reason *be expected to* and *be supposed to* will be left out of the picture in what follows.

- (23) Compulsory chores are a thing of the past, although you *are expected to* leave rooms tidy. (AHK 1582)

⁶ The BNC was queried using version 0.627 of the SARA client software.

- (24) By the time the meeting was over I was in such a state of excitement and fright that I forgot all about the clothing parcel I *was supposed to* collect. (B0U 2508)
- (25) By the year 2000, of the 40 million *expected to* be infected with the virus causing AIDS, 36 million will be in the developing world. (A02 189)
- (26) That all men laugh *is supposed to* be demonstrated from the premisses that all men are rational and that all rational things laugh. (ABM 460)

To find confirmation for the indications resulting from an earlier investigation based on a much smaller corpus that the substantive patterns we are interested in here are indeed typical of journalistic and academic texts (Noël 2003), their occurrence in the BNC as a whole (almost 100 million words) was compared with their frequency in two subcorpora of the BNC: a newspaper subcorpus (of almost 10 million words) and a subcorpus of academic natural science texts (of slightly over 1 million words).

The decision on which patterns to include was determined by the frequency list in (22). The 20 most frequent patterns were chosen, which, after the removal of *be expected to* and *be supposed to*, led to the 18 patterns listed by their descending order of frequency in the entire BNC in Table 1.

pattern	BNC	newspapers	science
<i>said to</i>	39.32	59.06	29.68
<i>thought to</i>	26.36	39.59	71.05
<i>found to</i>	18.26	13.27	99.83
<i>taken to</i>	17.57	9.42	32.38
<i>known to</i>	17.40	13.16	83.65
<i>seen to</i>	16.37	10.81	37.78
<i>believed to</i>	14.76	43.44	31.48
<i>reported to</i>	12.24	14.66	11.69
<i>considered to</i>	11.57	4.17	49.47
<i>shown to</i>	11.49	3.10	108.83
<i>held to</i>	8.14	4.28	7.20
<i>deemed to</i>	6.64	3.53	2.70
<i>assumed to</i>	6.18	1.60	35.08
<i>estimated to</i>	4.10	3.64	16.19
<i>claimed to</i>	3.49	1.50	1.80
<i>understood to</i>	3.37	14.23	0.90
<i>felt to</i>	2.66	0.86	0.90
<i>alleged to</i>	1.68	3.10	0.90

Table 1: The frequency of patterns of the kind [VERB_{PCU-en} *to*_{inf part}] in the entire BNC compared with their frequency in journalistic and scientific subcorpora of the BNC (occurrences per million words)

The numbers in this table are normalized frequencies, representing the number of instances per million words produced by searches for the past participle form of the verb immediately followed by the infinitival particle (*be* was left out of the query to include the cases where it is absent).⁷

Table 1 reveals that two patterns have a higher frequency in both of the specialized subcorpora than in the general corpus, viz. *be thought to* and *be believed to*, and that most of the other patterns are either typical of journalistic English or of scientific English. Patterns that are more frequent in newspapers than in both the general corpus and the science subcorpus are *be said to*, *be reported to*, *be understood to* and *be alleged to* (though in the case of *be reported to* the differences are rather small). Patterns that are more frequent in science texts than in both the general corpus and the newspaper subcorpus are *be shown to*, *be found to*, *be known to*, *be considered to*, *be seen to*, *be assumed to*, *be taken to* and *be estimated to*. Only four of the investigated patterns have a lower frequency in the two subcorpora compared to the whole BNC, viz. *be held to*, *be deemed to*, *be claimed to* and *be felt to*. On the whole, therefore, these results attest to the genre-specificity of these patterns. Moreover, given the nature of the domains to which they are specific — domains in which objectivity or factuality are required, which could make the occasional expression of evidentiality desirable — these results confirm the characterization of part of the functional potential of these patterns as evidential. On the other hand, though these patterns have lost some of their meaning, to the extent explained above, the genre-specificity of individual patterns also suggests that much of the verb meaning has been retained.

In view of the specific question this article is leading up to, it is interesting that the evidentials used in scientific texts do not merely point to (experimental) findings or scientific argumentation. Some that obviously do are *be shown to*, *be found to* and *be seen to*, as illustrated in (27) to (29).

- (27) This diversification has *been shown to* correspond closely to a simple exponential growth model. As the number of taxa increased the rate of diversification seems to have become diversity-dependent (Sepkoski 1978). (CMA 570)
- (28) In humans, in contrast, surgical removal of the hippocampus has *been found to* produce a profound and abiding loss of memory. (CMH 618)
- (29) This hypothesis can account for the fact that on cooling, rapid crystal growth *is seen to* occur which is inconsistent with the need for long range diffusion if the regularly folding lamellae were forming. (HRG 1053)

But science visibly also involves thoughts, believes, assumptions and... estimates. (30) to (33) provide examples of the patterns that point to them.

⁷ These queries were carried out using the Zurich BNCweb Query System.

- (30) The combination of high precipitation, water surpluses, large number of wet days and low insolation experienced in highly oceanic areas *is thought to* increase the rate of growth and the competitive abilities of bryophytes, notably Sphagnum species, hypnoid mosses and Racomitrium (Poore & McVean 1957), all of which are very conspicuous in plant communities in the Western Isles. (AML 443)
- (31) The thymus *is believed to* play a central role in the induction of autoimmunity in MG, and thymectomy generally leads to clinical improvement. (FTB 395)
- (32) Sporadic nucleation *is assumed to* be a first-order mechanism and if we consider that a two-dimensional disc is formed, then <formula>. (HRG 1100)
- (33) A doubling of global carbon dioxide concentration *is estimated to* increase ozone concentration by between 3 and 6 per cent (Maugh 1984; US National Research Council 1984). (GU5 583)

In the next section texts from the domain of economics will be added to the equation. It will focus on two patterns that are obviously very much part of the evidential repertoire of scientific texts, though the first more so than the second, viz. *be found to* and *be estimated to*. It will be interesting to find out whether these patterns are present in similar or different proportions in economics texts.

4. *Be found to* and *be estimated to* in science and economics texts

Sadly, though there is a genre/text domain label in the BNC identifying texts as both academic and natural scientific, there is no corresponding label marking texts as both academic and economic.⁸ However, there is a label ‘commerce’ and though not all texts bearing this label could strictly speaking be qualified as academic, most of them probably can. In this section, the texts carrying this label will be used as a ready-made subcorpus (of about 3.75 million words) to be contrasted with the scientific subcorpus (of slightly over a million words) already used in the previous section. It should be borne in mind, however, that these corpora may not be as comparable as they should have been.

Table 2 compares the frequencies of *be found to* and *be estimated to* in these two subcorpora. Again the numbers in this table are normalized frequencies, representing the number of instances per million words produced by searches for the past participle form of the verb immediately followed by the infinitival particle.

⁸ Reference here is to ‘David Lee’s genre classification scheme’ included in the Zurich BNCweb Query System.

pattern	science	economics
<i>found to</i>	99.83	33.52
<i>estimated to</i>	16.19	4.52

Table 2: The frequency of *(be) found to* and *(be) estimated to* in scientific and economic subcorpora of the BNC (occurrences per million words)

Three observations can be made: 1. *be found to* and *be estimated to* are present in both science and economics texts; 2. the numbers in the economics column are lower, both for *be found to* and *be estimated to*, than in the science column; 3. the numbers for *be estimated to* are lower than for *be found to* both in the science column and in the economics column. The first observation is not a trivial one. We already knew from Table 1 that both patterns occur in science texts, but now we also know that, contrary to expectations raised in section 1, *be found to* regularly occurs in economics texts as well. Examples are (34)-(36).

- (34) Parallel with the shift in emphasis epitomised by the concept of human resource management is the growing emphasis on ‘excellence’ and ‘quality’ as the criteria for effective management. The movement for excellence is most widely known through the work of Peters and Waterman (1982). They identified a variety of factors which *were found to* be held in common by a number of American companies recognised as meeting the criteria for excellence. (AM7 1080)
- (35) Control is widely defined as the ability to exercise a decisive influence over a company by any means. As more cases are examined by the Commission, the precise meaning and ambit of the term ‘decisive influence’ will be clarified. In one case, a company *was found to* have a decisive influence with a 39% shareholding, as none of the other blocks of shareholdings exceeded 4%, and so the company was in a relative position of strength. (BP5 1220)
- (36) The somewhat weaker relationship shown in Figure 4.2, however, is perhaps less intuitively apparent. Here the level of bargaining (again shown horizontally) is plotted against the level of unionisation (vertically). There *is found to* be a consistent tendency for higher levels of bargaining to be associated with a greater degree of union organisation. (CLE 1090)

Given that the two corpora are not completely comparable, we should perhaps be careful not to conclude too much from the second observation.

If the economics corpus does not consist entirely of academic texts, there might be texts in there that do not ‘require’ evidential expressions as much as the texts in the other corpus, or texts that require different patterns.

pattern	science	economics
<i>shown to</i>	108.83	13.30
<i>known to</i>	83.65	14.63
<i>thought to</i>	71.05	16.76
<i>considered to</i>	49.47	21.81
<i>seen to</i>	37.78	35.11
<i>assumed to</i>	35.08	34.58
<i>taken to</i>	32.38	35.38
<i>believed to</i>	31.48	9.04
<i>said to</i>	29.68	35.64
<i>reported to</i>	11.69	1.86
<i>held to</i>	7.20	14.10
<i>deemed to</i>	2.70	26.33
<i>claimed to</i>	1.80	3.46
<i>understood to</i>	0.90	2.93
<i>felt to</i>	0.90	2.13
<i>alleged to</i>	0.90	0.80

Table 3: The frequency of patterns of the kind [VERB_{PCU-en} to_{inf part}] other than (*be*) *found to* and (*be*) *estimated to* in scientific and economic subcorpora of the BNC (occurrences per million words)

If we go on to compare the frequencies of the other patterns, represented in Table 3, we notice that the frequencies in the economics texts are neither consistently nor proportionally lower than in the science texts. Some patterns have a very similar frequency in both corpora (*be seen to*, *be assumed to*, *be taken to*) and some are more frequent in the economics texts (*be said to*, *be held to*, *be deemed to*). If the frequency in the economics texts is lower, it is sometimes more drastically lower than in the case of *be found to*. The most extreme difference is that of the case of *be shown to*, apparently making the science text example (37) much more typical of its genre than economics text example (38).

- (37) Chloroform should not be used under any circumstances. Not only is it hepatotoxic but trace concentrations have *been shown to* interfere seriously with the breeding performance of male mice. (EV6 239)
- (38) The evidence presented is consistent with a standard single equation approach to asset demands as the level and growth of wealth together with expected relative returns *are shown to* be important determinants of the level of investment. (H9A 1310)

Future research based on truly comparable corpora will have to establish whether much may be concluded from these differences.

Potential differences in the composition of the two subcorpora cannot account for the fact that the proportional relation between *be found to* and *be estimated to* in these corpora is very similar, however. As was the case with the first one, this third observation goes against the expectations created by the Schumacher quote in section 1. If indeed economists are constantly making estimates, more so than scientists, as Schumacher implies, this certainly does not show up in the choices made from the set of evidential expressions discussed here.

5. Conclusion

Evidential patterns like *be said to*, *be thought to*, *be seen to*, *be found to*, *be estimated to*, etc., which can be considered to be substantive instances of a schematic, grammatical *be said to* construction, are not distributed evenly over all kinds of text. The construction is typical of journalistic and scientific texts, but these display a different preference for particular instantiations. If the kind of argumentation employed in economics is different from the kind used in the (natural) sciences, one might also expect economics texts to show a specific preference. There are indications that there is some variation between science texts and economics texts in this respect, but these need to be corroborated by a comparison of truly comparable corpora. However, indications so far do not suggest that economics is much more a matter of estimates than findings. Even though this does not establish economics to be a science, things do not look as bad for the economist as they may have done at the start of this contribution, therefore.

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